

# The PARC Lesion: A Proximal Avulsion of the Radiocarpal Capsule

Francis Bonte, MD<sup>1</sup> Christophe L. Mathoulin, MD, PhD<sup>2</sup>

<sup>1</sup>Department of Orthopaedics and Traumatology, Upper Limb Unit, AZ Sint-Jan AV Brugge – Oostende, Bruges, Belgium

<sup>2</sup>Clinique Jouvenet, Institut de la Main, Paris, France

Address for correspondence Christophe L. Mathoulin, MD, PhD, Institut de la Main, 6 Square Jouvenet, Paris, France (e-mail: cmathoulin@orange.fr).

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## Abstract

**Purpose** A proximal avulsion of the radiocarpal capsule (PARC) is a cause of persisting posttraumatic wrist pain. This lesion is often overlooked and left untreated during wrist arthroscopy.

**Materials and Methods** A record review was performed on 13 patients with this lesion who underwent diagnostic wrist arthroscopy after failed conservative treatment. We retrospectively reviewed the results of an arthroscopic repair method in 13 patients.

**Results** In 11 of the 13 consecutive cases the lesion was sutured using an arthroscopic dorsal capsule-ligamentous repair technique. Postoperatively, all high-demand patients were able to return to their previous sports.

**Discussion** The PARC lesion is usually overlooked during diagnostic arthroscopy since it may be covered by synovial or fibrous tissue. It often coexists with scapholunate ligament or triangular fibrocartilage complex injuries. This lesion is amenable to an arthroscopic repair with satisfactory clinical results.

## Keywords

- PARC lesion
- wrist arthroscopy
- radiocarpal
- capsular tear

A proximal avulsion of the radiocarpal capsule (PARC) is a cause of persisting posttraumatic wrist pain. This lesion is often overlooked and left untreated during wrist arthroscopy.

This lesion probably results from a blunt trauma; however, it also appears after a fall on an outstretched hand. Concomitant lesions such as a scapholunate ligament injury, dorsal capsulo-scapholunate septum, and dorsal triangular fibrocartilage complex (TFCC) tears, are more obvious and so the capsular tear is often overseen or forgotten. Arthroscopic exploration often does not reveal any tear, since it is often hidden by overlying fibrous tissue especially in chronic cases. However, debridement with the shaver reveals a detachment and/or rupture of the dorsal capsule.

A traumatic event appears to create an avulsion tear of the dorsal wrist capsule. The extent of the lesion is variable: from a lesion of the radiocarpal capsule with expansion into the dorsal TFCC in the ulnar direction (→ **Figs. 1** and **2**) to a more extensive lesion into the dorsal capsulo-scapholunate septum (DCSS) (→ **Fig. 3**)<sup>1</sup> and scapholunate interosseous ligament,<sup>2–7</sup>

we have termed this a PARC lesion: proximal avulsion of the radiocarpal capsule.

## Material and Methods

Overall, 13 consecutive patients with posttraumatic wrist pain were all treated arthroscopically. In seven cases, the wrist was injured by a fall on an outstretched hand in neutral. In three cases, the trauma-mechanism was unknown or could not be specified by the patient. In one case, the mechanism of injury consisted of a sudden block of the palmar side of the hand while performing a forehand swing (playing tennis). In the second case, there was a sudden interruption of a golf swing with the golf club hitting the ground. Indications for surgery were wrist pain at rest and with motion. Slight distal radioulnar joint (DRUJ) pain and instability was noticed in three patients. Seven patients complained of dorsal wrist pain, while three patients complained of palmar or internal wrist pain, with a positive scapholunate ballotement test.

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**Fig. 1** Dorsal TFCC lesion with expansion into the dorsal radiocarpal capsule (arrow). TFCC, triangular fibrocartilage complex.



**Fig. 2** Complete avulsion of the dorsal radiocarpal capsule from its insertion of the radial rim (arrows).

One patient complained of constant dorsal wrist pain, which was especially aggravated while playing tennis.

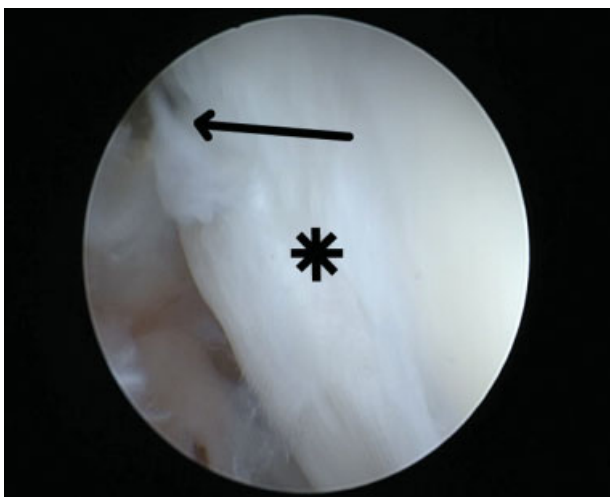
The mean time between the date of injury and the first examination was 7 months (range, 1–22 months). The time from the initial examination to surgery was 13 weeks (range, 1–16 weeks). One patient was initially treated with cast immobilization for an associated scaphoid fracture. The Other patients were treated with night splinting.

X-rays were inconclusive in the majority of cases, however, in three cases a slightly widened scapholunate gap with a clenched fist view were noticed but without a dorsal intercalated segmental instability pattern. A scaphoid fracture was seen in one case. Arthro-computed tomography and arthro-magnetic resonance imaging were performed in all patients. Dorsal TFCC tears were noticed in six cases, foveal tears in two cases, and a central

tear in one case. Scapholunate tears were found in five cases, of which two combined with a dorsal TFCC tear. In only two cases, a tear of the radiocarpal capsule was suspected. These patients presented early after trauma. The scapholunate instability was scored peroperatively using the European Wrist Arthroscopy Society (EWAS) classification, which ranged from 2 to 3C (2 × 2, 5 × 3B, 6 × 3C) in this series (►Table 1).<sup>8</sup>

In all, 11 cases, a double loop dorsal TFCC suture was performed, as well as an arthroscopic dorsal capsuloligamentous repair (ADCLR), using resorbable sutures. In two cases, an isolated ADCLR was performed for an isolated radiocarpal tear with a torn DCSS. Postoperatively, the wrist was immobilized in extension for 6 weeks.

All patients were reviewed by C.L.M. at regular 3 month, testing range of motion of the wrist, disabilities of the arm, shoulder and hand (DASH), and visual analog score (VAS) and grip strength, using the Jamar dynamometer (Preston, Cambridge, MA).



**Fig. 3** Torn DCSS (arrow), scapholunate ligament (asterisk). DCSS, dorsal capsulo-scapholunate septum.

## Operative Technique

Wrist arthroscopy was performed on an outpatient basis under regional anesthesia and with an upper arm tourniquet. The elbow flexed to 90 degrees on an arm table and the hand suspended using a hand holder with traction of 3 to 5 kg.

Standard arthroscopic portals, 3–4 and 6R, were used for the radiocarpal joint, as well as the midcarpal radial (MCR) and midcarpal ulnar (MCU) portals for the midcarpal joint. After insufflation of the joints with normal saline, small transverse skin-incisions were made with a 15-blade scalpel, followed by blunt dissection with a mosquito forceps, making sure not to harm any neurovascular structures or tendons. The 2.4-mm arthroscope was introduced through the 3–4 portal and the instruments through the 6R portal. With the probe, the insertions of the TFCC were checked performing

**Table 1** Arthroscopic EWAS clarification and corresponding AP findings in cadaver specimens

Arthroscopic stage (EWAS)	Arthroscopic testing of SLIOL from MC joint	AP findings
I	No passage of the probe	Not found in these cadaver specimens
II: Lesion of membranous SLIOL	Passage of the tip of the probe in the SL space without widening (stable)	Lesion of proximal/membranous part of SLIOL
III A: Partial lesion involving the volar SLIOL	Volar widening on dynamic testing from MC joint (anterior laxity)	Lesion of anterior and proximal part of SLIOL with or without lesion of RSC–LRL
III B: Partial lesion involving the dorsal SLIOL	Dorsal SL widening on dynamic testing (posterior laxity)	Lesion of proximal and posterior part of SLIOL with partial lesion of DIC
III C: Complete SLIOL tear, joint is reducible	Complete widening of SL space on dynamic testing, reducible with removal of probe	Complete lesion of SLIOL (anterior, proximal, posterior), complete lesion of one extrinsic ligament (DIC lesion or RSC/LRL)
IV: Complete SLIOL with SL gap	SL gap with passage of the arthroscope from MC to RC joint No radiographic abnormalities	Complete lesion of SLIOL (anterior, proximal, posterior), lesion of extrinsic ligaments (DIC, and RSC/LRL)
V	Wide SL gap with passage of the arthroscope through SL joint Frequent X Ray abnormalities such as an increased SL gap, DISI deformity	Complete lesion of SLIOL, DIC, LRL, RSC, involvement of one or more other ligaments (TH, ST, DRC)

Abbreviations: AP, anatomic-pathological; DIC, dorsal intercarpal ligament; EWAS, European Wrist Arthroscopy Society; LRL, long radiolunate; MC, midcarpal; RSC, radio-scapho-capital; SL, scapholunate; SLIOL, scapholunate interosseous ligament; ST, scaphotrapezial; TH, triquetral-hamate.

the hook test (for foveal detachment)<sup>9–11</sup> and trampoline test (for peripheral detachment). A positive trampoline test can be seen in the case of a recent tear of the dorsal portion of the TFCC.<sup>12</sup>

With the camera in the 3–4 portal and the shaver in the 6R portal, the dorsal portion of the TFCC is evaluated and debrided if necessary. A detachment of the dorsal TFCC is very suspicious in case of a positive trampoline test. This dorsal tear was first clearly described by Estrella et al in 2007<sup>13</sup> as being located in the area between the extensor carpi ulnaris subsheath and the extensor digiti minimi. In case of a detachment of the dorsal TFCC with extension into the radiocarpal capsule, however, the dorsal portion of the TFCC may float distally and so diminish the ulnocarpal space, especially when the scope is in the 6R portal. This large lesion differs from a dorsal TFCC tear by its extent. A dorsal TFCC tear extends from the styloid process and to its insertion on the radius. In the PARC lesion, however, there is a continuation of the dorsal TFCC tear, into the dorsal radiocarpal capsule and dorsal intercarpal ligament to the level of the ridge between scaphoid and lunate facet. In both cases, the foveal insertion is intact, which explains the stable distal radioulnar joint in most of our cases.

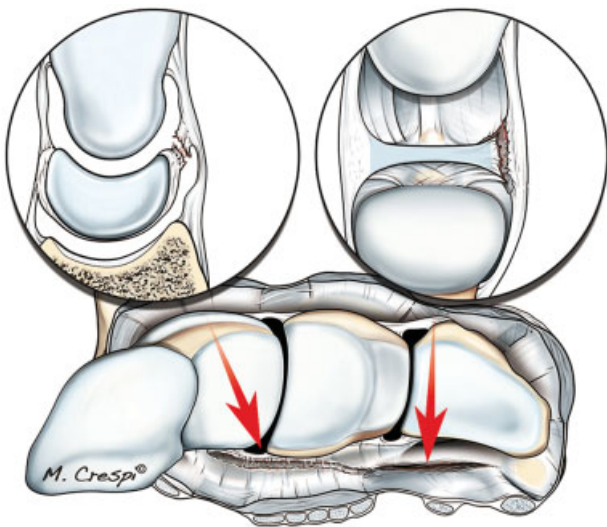
With a shaver in the 6R portal, the insertion of the dorsal radiocarpal capsule is debrided to obtain a clear view of its insertion. Due to fibrotic tissue or synovitis, a complete detachment of the dorsal capsule may be hidden (→Fig. 4). Abe et al<sup>14</sup> described this for dorsal TFCC tears and noted that the tear was often obscured by a reactive synovitis and was not visible until this synovitis was debrided. After switching portals (camera in 6R and shaver in 3–4), the radial extension of the dorsal capsule detachment can be evaluated. To have a clear view, it is important to rotate the 30-degree scope to

visualize the dorsal carpal capsule. Indeed, the lesion can extend into the DCSS in the direction of the second metacarpal (→Figs. 5 and 6), as well as in the direction of the dorsal TFCC to its foveal insertion.

As treatment of a large tear of the dorsal portion of the TFCC combined with an avulsed radiocarpal capsule, a double loop suture is performed. A needle is placed approximately 1 cm under the 6R portal (distal radioulnar portal) and passes just volarly to the center of the TFCC tear. A skin incision is



**Fig. 4** Shaving (asterisk) the tissue covering the dorsal radiocarpal avulsion (arrow).

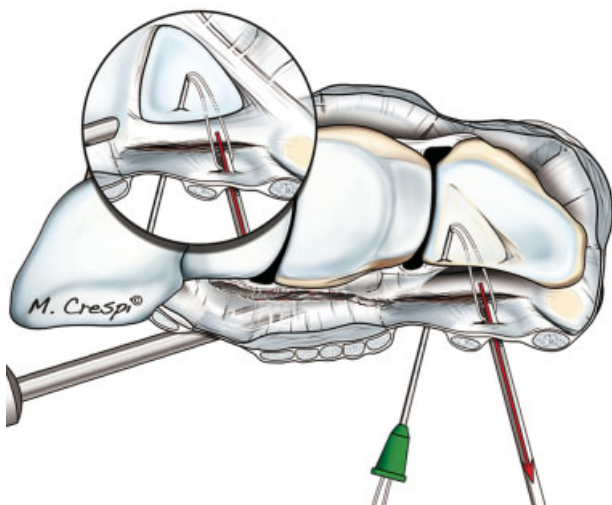


**Fig. 5** Posterior avulsion of the radiocarpal capsule with expansion in the dorsal TFCC. TFCC, triangular fibrocartilage complex.

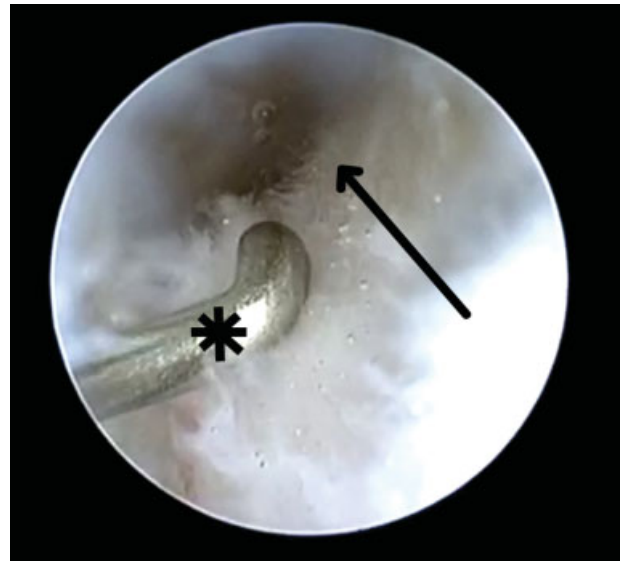
made. A loaded needle with a loop of absorbable monofilament (3-0) passes the capsule and the dorsal TFCC (► **Fig. 7**).

Through the 6R portal, the suture loop is then retrieved using a mosquito forceps. To perform the double loop suture, two other monofilament sutures are placed through the same distal radioulnar portal, passing the TFCC, one radially and one ulnarly (close to the styloid recess) of the loop suture (► **Figs. 8 and 9**).

Again, these sutures (3-0 or 4-0 absorbable monofilament, depending on the wrist size) are retrieved through the 6R portal, using the mosquito forceps. The ends of the single suture are then passed through the central loop and by pooling the loop, a double loop suture is constructed, with reduction and stabilization of the floating dorsal portion of the TFCC as well as the ulnar part of the radiocarpal capsule tear (► **Fig. 10**). After releasing the vertical traction, and



**Fig. 7** A loaded needle is passed through the dorsal TFCC. TFCC, triangular fibrocartilage complex.



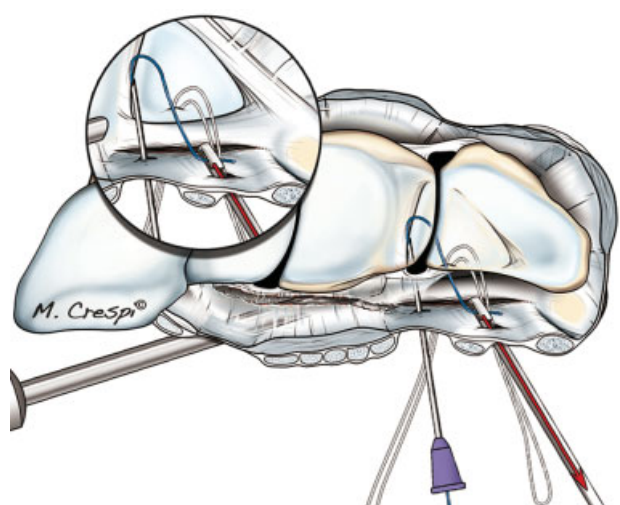
**Fig. 6** Palpator (asterisk) showing the avulsed DCSS (arrow). DCSS, dorsal capsulo-scapolunate septum.

holding the wrist in extension and ulnar deviation, the suture knot is tied subcutaneously (► **Figs. 11–13**).

For the radially extended tear, an ADCLR is performed.<sup>15</sup> This is also the arthroscopic treatment of a reducible scapholunate ligament tear (EWAS 3A-B-C, 4, 5). Very often, a posttraumatic predynamic or dynamic instability of the scapholunate ligament is diagnosed, arthroscopically.

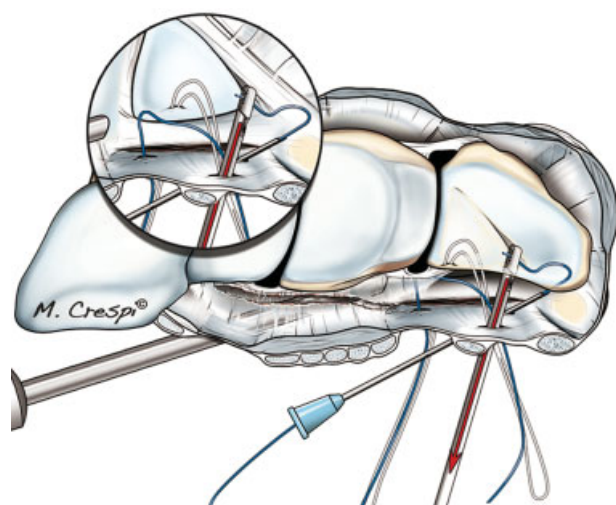
Under direct vision of the scope, two loaded needles (with absorbable monofilament 3-0 or 4-0) are inserted through the 3-4 portal, trying to catch both borders of the capsular tear, passing the dorsal scapholunate ligament (► **Figs. 14 and 15**).

The needles are positioned in an oblique manner from dorsal to palmar and proximal to distal (► **Fig. 16**). Of course, the extensor pollicis longus and extensor carpi radialis brevis tendons have to be avoided while placing the needles. Afterwards the scope is switched to the MCU portal. Both tips of the

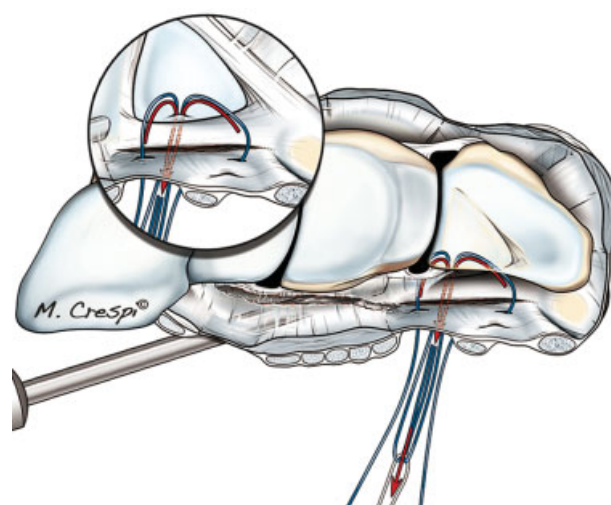


**Fig. 8** One monofilament wire stabilizes the dorsal TFCC radially. TFCC, triangular fibrocartilage complex.

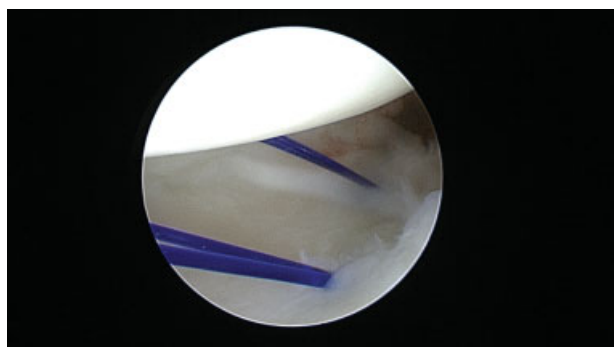




**Fig. 9** A second wire is situated ulnarly.



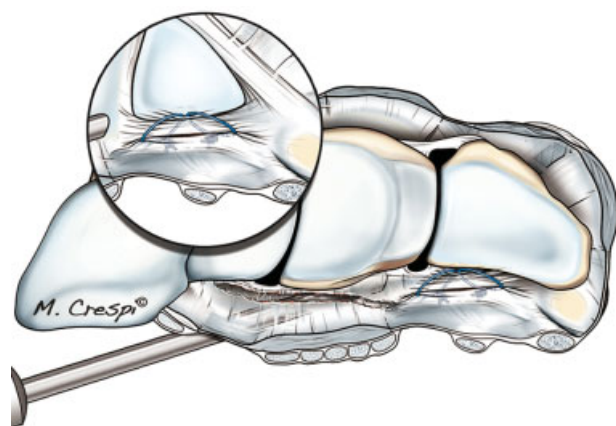
**Fig. 10** Double loop fixation technique.



**Fig. 11** Two wires through the dorsal TFCC. TFCC, triangular fibrocartilage complex.

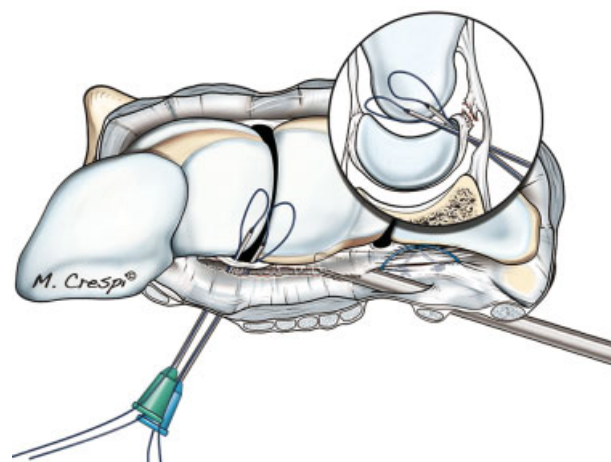


**Fig. 12** Double loop fixation, intraoperatively.



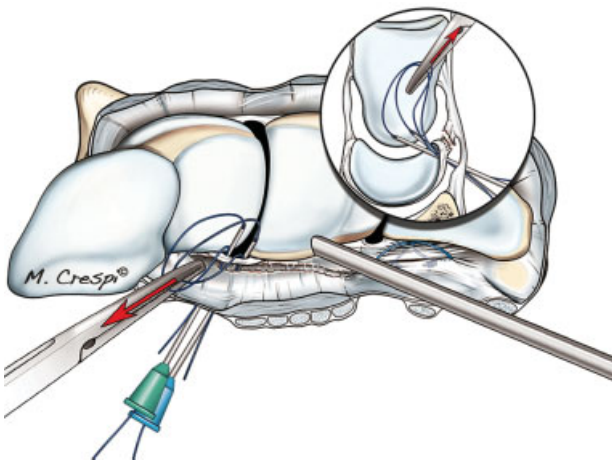
**Fig. 13** Double loop fixation.

needles and monofilament sutures are visible in the midcarpal joint, piercing the dorsal scapholunate ligament. Through the MCR portal, both sutures are then retrieved with a mosquito forceps under direct vision from the MCU portal (→ Fig. 17). By tying a proximal knot between the two sutures and pulling on both suture ends through the 3–4 portal, the knot is placed in between the scaphoid and lunate,



**Fig. 14** Performing ADCLR procedure. ADCLR, arthroscopic dorsal capsuloligamentous repair.

into the midcarpal joint. After releasing the vertical traction and holding the wrist in extension, a second knot is tied between the two proximal ends and introduced in the 3–4 portal incision, dorsal to the capsule. The net effect of this achieves a closure of the gap in the dorsal capsule, as well as a



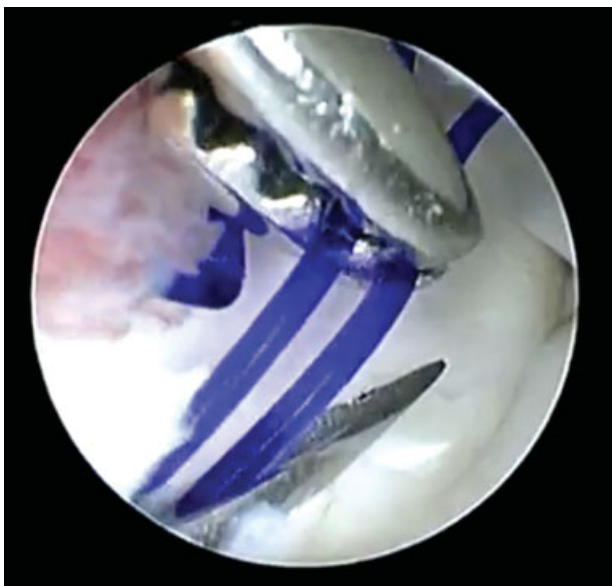
**Fig. 15** Mosquito forceps in MCR portal. MCR, midcarpal radial.

repair of the capsuloligamentous complex and scapholunate ligament (► **Figs. 18** and **19**).

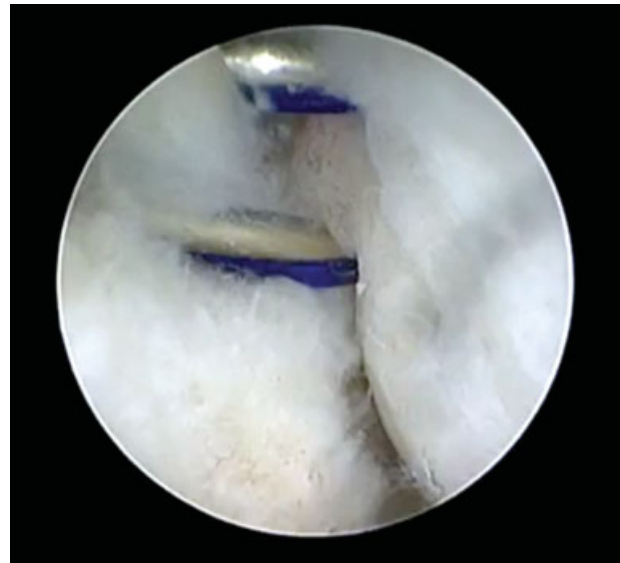
In case of a large lesion with communication from dorsal TFCC portion to DCSS and scapholunate ligament, a combined treatment can be performed: double loop suturing plus dorsal capsuloligamentoplasty.

## Results

In this series, there were nine male and four female patients with a mean age of  $34 \pm 9$  years (range, 20–50 years). The dominant side was involved in 10 cases. The mean time from the initial injury was  $8 \pm 6.44$  months (range, 1–24 months). The motion of the unaffected wrist included a mean extension and mean flexion of  $73 \pm 11$  degrees (range, 60–90 degrees) and  $70.8 \pm 11$  degrees (range, 60–85 degrees), respectively. Extension and flexion at the affected wrist were preoperatively  $71 \pm 11.59$  degrees (range, 60–90



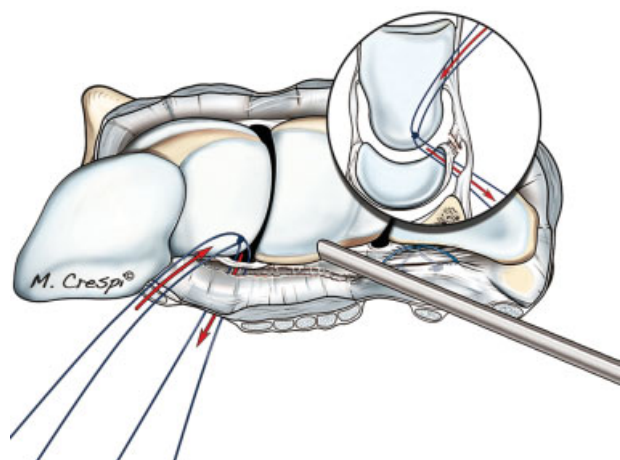
**Fig. 17** Mosquito forceps retrieving both wires.



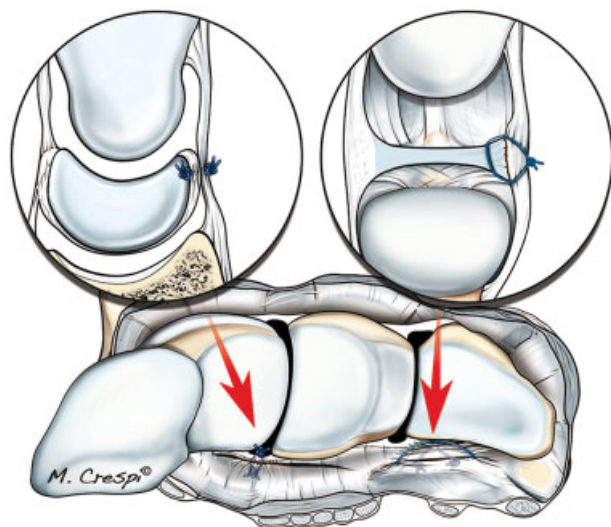
**Fig. 16** Both wires positioned in both remnants of the scapholunate ligament.

degrees) and  $68 \pm 10$  degrees (range, 60–80 degrees), while postoperatively  $80 \pm 8$  degrees (range, 70–90 degrees) and  $68 \pm 10$  degrees (range, 50–80 degrees). The mean difference between the post- and preoperative extension was  $9 \pm 8$  degrees (range, 0–25 degrees), while the mean difference between the post- and preoperative flexion was  $2 \pm 11$  degrees (range, –20 to 20 degrees). Preoperative and postoperative pronation and supination were symmetrical and comparable. No restriction in range of motion was observed. No foveal tear of the TFCC was seen intraoperatively. The mean postoperative grip strength of the affected side was  $44 \pm 12.4$  kg (range, 25–60 kg) as compared with the mean preoperative grip strength of  $28 \pm 11$  (range, 14–40 kg). The mean postoperative grip strength of the operated side was 89.3% of the unaffected side.

The mean postoperative DASH score was  $4.6 \pm 5.7$  as compared with a mean preoperative DASH score of



**Fig. 18** A knot will stabilize the torn dorsal scapholunate ligament.



**Fig. 19** ADCLR and double loop procedure. ADCLR, arthroscopic dorsal capsuloligamentous repair.

$48 \pm 21$ . The mean preoperative VAS score was  $5.6 \pm 1.5$  (range, 3–8). Postoperatively, the mean VAS score was  $1.2 \pm 1$  (range, 0–3). Instability tests (ballottement) were negative in all cases, postoperatively. As well as the DRUJ laxity test. Tenderness at the dorsal TFCC disappeared postoperatively.

## Discussion

A proximal lesion of the radiocarpal capsule has not been described. This lesion may be a reason for persisting post-traumatic wrist pain.<sup>16–18</sup>

Obscuring overlying fibrotic tissue is one reason why concomitant lesions are left unexplored and left untreated.<sup>19</sup>

The specific trauma mechanism for the PARC lesion is unknown. We believe that it results from a blunt wrist trauma, which causes a traumatic avulsion of the radiocarpal capsule at the radius insertion. A sudden block to wrist flexion during a swing such as a forehand in tennis or a blocked golf swing seems to be a mechanism of injury. In these cases, the dorsal capsule is under tension, while the carpus is abruptly, dorsally translated (due to the sudden palmar block).

In only three cases, a slight widening of the scapholunate joint was seen on X-ray with a clenched fist view. Arthroscopically, however, scapholunate ligament tears were seen in 11 cases (EWAS  $5 \times 3B$  and  $6 \times 3C$ ).

Preoperative scans were inconclusive and did not show the extensiveness of the lesions.

Although this series only includes 13 patients, of which 2 after a specified trauma without fall on an outstretched hand, we assume many more cases are left undiagnosed as a PARC lesion, after a diagnostic or therapeutic wrist arthroscopy. Comprehensive inspection and debridement of the dorsal radiocarpal capsule is very important in all cases. A

well-treated PARC lesion using the described surgical technique shows satisfying postoperative results.

## Conflict of Interest

None.

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